ONline Ethernet 10BASE-FL Module Installation and Operation Guide

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Model Number: 5104M-FL1

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Federal Communications Commission Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you must correct the interference at your own expense.

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Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur la matériel brouilleur: "Appareils Numériques", NMB-003 édictée par le Ministère des Communications.

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus", ICES-003 of the Department of Communications.

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Hiermit wird bescheinigt, dass der 5104M-FL1 in Üebereinstimmung mit den Bestimmungen der Vfg 243/1991 funkentstöert ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Geraetes angezeigt und die Berechtigung zur Üeberprüefung der Serie auf Einhaltung der Bestimmungen eingeräeumt.

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This is to certify that the 5104M-FL1 is shielded against radio interference in accordance with the provisions of Vfg 243/1991.

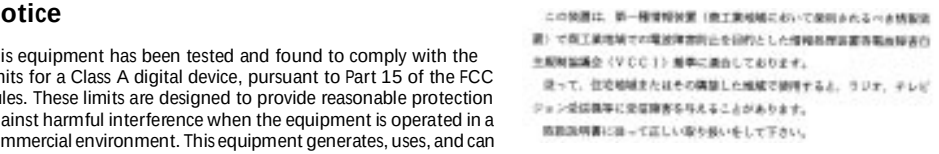
The German Postal Services have been advised that this equipment is being placed on the market and that they have been given the right to inspect the series for compliance with regulations.

Compliance with applicable regulations depends on the use of shielded cables. The user is responsible for procuring the appropriate cables.

EN55022/CISPR22 Compliance

This equipment conforms to the Class A emissions limits for a digital device as defined by EN55022 (CISPR22).

VCCI Class 1 Compliance



This equipment is in the 1st Class category (information equipment to be used in commercial or industrial areas) and conforms to the standards set by the Voluntary Control Council for Interference by Information Technology Equipment aimed at preventing radio interference in commercial or industrial areas.

Consequently, when the equipment is used in a residential area or in an adjacent area, radio interference may be caused to radio and TV receivers, and so on.

Read the instructions for correct handling.

Fiber Cable Classification Notice

Use this equipment only with cable classified by Underwriters Laboratories as to fire and smoke characteristics in accordance with Section 770-2(b) and Section 725-2(b) of the National Electrical Code.

UK General Approval Statement

The ONcore Switching Hub, ONline System Concentrator, and ONsemble StackSystem Hub are manufactured to the International Safety Standard EN 60950 and are approved in the UK under the General Approval Number NS/G/12345/J/100003 for indirect connection to the public telecommunication network.

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How to Use This Guide

This guide is designed to help you understand the features, indicators, and installation procedure for the 3Com ONline™ Ethernet 10BASE-FL Module (Model Number 5104M-FL1). Information on troubleshooting and diagnostics are included. This guide also contains network configuration information.

Audience

This guide is intended for the following people at your site:

- ❑ Network manager or administrator
- ❑ Hardware installer

Structure of This Guide

This guide contains the following chapters and appendix:

Chapter 1 - Introduction – Introduces the principal features of the ONline Ethernet 10BASE-FL Module.

Chapter 2 - Designing and Expanding the Network – Shows and explains examples of network configurations using the ONline System Concentrator and the ONline 10BASE-FL Module.

Chapter 3 - Installing and Operating the Module – Provides illustrated procedures for installing the 10BASE-FL Module into the ONline System Concentrator.

Chapter 4 - Troubleshooting – Provides help in isolating and correcting problems that may arise during the installation process and during normal operation.

Appendix A - Specifications – Provides product dimensions, power requirements, and other specifications for the module.

Appendix B - Technical Support – Lists the various methods for contacting the 3Com technical support organization and for accessing other product support services.

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Document Conventions

This section describes document conventions.

Text Conventions

Text	Convention	Example
System output	Courier text	After you click Apply, the system displays the message `Transmitting Data`.
User input		In the Agent Information Form, enter `Support` in the New Contact field.
Pathnames, Filenames	Plain text	Before you begin, read the readme.txt file located in /usr/snm/agents.
User-substituted identifiers	Italic text in braces	Use the following command to show port details: `SHOW PORT {`*`slot`*`.all} VERBOSE`
Key or key sequence	Initial-capitalized plain text	To refresh the screen, press Ctrl-R.
Button		Click Cancel.
Menu selection		To save the configuration, select File→Save.
Text emphasis, Document titles	Italic text	Click Apply *after* you add the new search parameters.

Notes, Cautions, and Warnings

A note indicates information that is important:

Note: Use STP lobe cables for your system.

A caution indicates a condition that may damage software or hardware:

Caution: Do not put your installation diskettes on a magnetic surface. This may damage the diskettes.

A warning indicates a condition that may threaten personal safety:

Warning: Wear eye protection when performing the following maintenance procedures.

Related Documents

This section provides information on supporting documentation, including:

- 3Com Documents
- Reference Documents

3Com Documents

The following documents provide additional information on 3Com products:

17-Slot ONline System Concentrator Installation and Operation Guide – Explains how to install, operate, and manage the 3Com ONline 17-Slot System Concentrator (Models 5017C-LS and 5017C with load sharing).

6-Slot ONline System Concentrator Installation and Operation Guide – Explains how to install, operate, and manage the 3Com ONline 6-Slot System Concentrator.

ONline Ethernet Management Module Installation and Operation Guide – Describes how to install the ONline Ethernet Network Management Module in the ONline System Concentrator and explains the LEDs on the module faceplate. This guide also provides instructions for connecting a terminal to the module and describes the management commands necessary to perform management tasks on the concentrator and on remote devices.

ONline Management Commands Guide – Provides an alphabetized reference resource describing all ONline management commands.

For a complete list of 3Com documents, contact your 3Com representative.

Reference Documents

The following documents supply related background information:

Case, J., Fedor, M., Scoffstall, M., and J. Davin, *The Simple Network Management Protocol*, RFC 1157, University of Tennessee at Knoxville, Performance Systems International and the MIT Laboratory for Computer Science, May 1990.

Rose, M., and K. McCloghrie, *Structure and Identification of Management Information for TCP/IP-based Internets*, RFC 1155, Performance Systems International and Hughes LAN Systems, May 1990.

1 Introduction

This chapter introduces you to the 3Com ONline™ Ethernet 10BASE-FL Module (Model Number 5104-FL1) and provides an overview of its features.

This chapter contains the following sections:

- 10BASE-FL Module Description
- 10BASE-FL and FOIRL IEEE Standards Comparison
- Theory of Operation

10BASE-FL Module Description

The ONline Ethernet 10BASE-FL Module is a 4-port, fiber repeater module designed for the 3Com ONline System Concentrator. The module provides 10BASE-FL backbone connectivity for Ethernet local area networks. It also provides direct 10BASE-FL to-the-desk connectivity.

The 10BASE-FL Module:

- Meets the 802.3 distance recommendation of two kilometers between any two concentrators
- Supports network diameters up to 4 kilometers
- Contains built-in link redundancy for fault tolerance
- Includes extensive diagnostics for rapid troubleshooting
- Provides 10 Mbps performance with 100 percent collision detection using CSMA/CD
- Provides backward compatibility with FOIRL-compliant equipment
- Supports 50, 62.5, 85, and 100 µm fiber cable
- Is shipped with ST, SMA, or FC connectors
- Features "hot swap" capability

Before installing the 10BASE-FL Module, read the *ONline System Concentrator Installation and Operation Guide.*

10BASE-FL and FOIRL IEEE Standards Comparison

10BASE-FL is a subpart of a IEEE standard called 10BASE-F (802.3, section 18), which standardizes three types of Ethernet-over-fiber optic cable.

Table 1-1 describes each 10BASE-F standard

Table 1-1. 110BASE-F Standards

10BASE-F Standard	Description
10BASE-FB	"FB"indicates "fiber backbone." The optimal use for this version of fiber Ethernet is as a fiber backbone.
10BASE-FP	"FP" indicates "fiber passive" network. This standard specifies a fiber optic connection method that passively splits the fiber optic light from each station among all the others, entirely within the optical domain.
10BASE-FL	"FL" indicates "fiber link." A superset of the 1987 IEEE FOIRL standard, the 10BASE-FL standard ensures compatibility between FOIRL and 10BASE-FL equipment. However, observe the more limiting FOIRL parameters if you interoperate with FOIRL-compliant equipment.

Theory of Operation

Use the 10BASE-FL Module to connect directly to a 10BASE-FL or FOIRL-compatible device (such as the 3Com model 5101T-FL1 10BASE-FL Transceiver). However, you can also use the module as your network backbone link for connecting concentrators together. Connections of both types are shown in Figure 1-1

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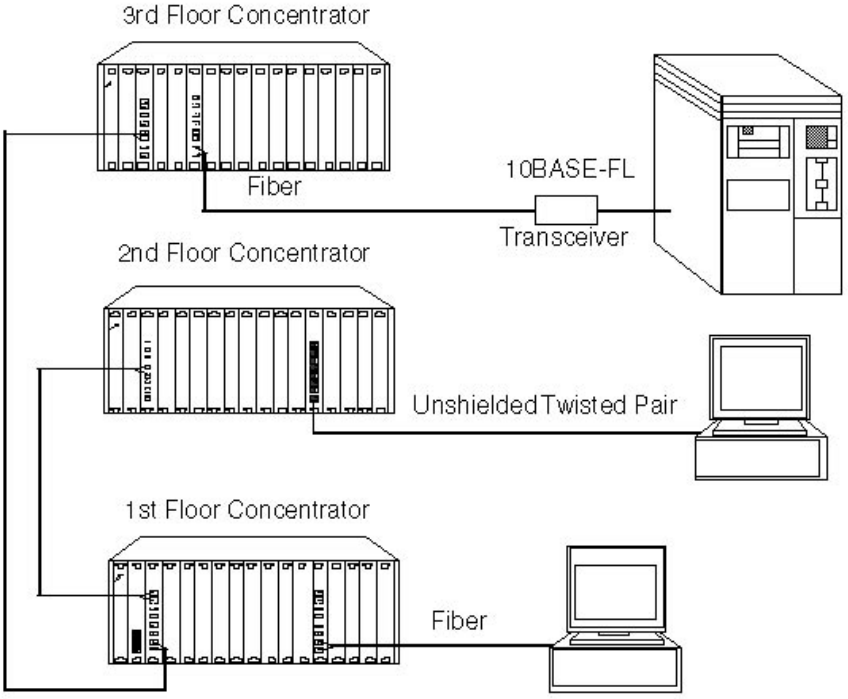

Figure 1-1. 10BASE-FL Module Connections

2 Designing and Expanding the Network

This chapter contains configuration information that will help you to plan your network. Install all equipment using only approved cables for proper operation. Refer to Appendix A, the section Fiber Cables and Connectors, for information on fiber cable and connector requirements.

This chapter contains the following sections:

- Understanding the General Rules
- Determining Maximum 10BASE-FL Link Distances
- Choosing a Network Backbone Cabling Structure
- 10BASE-FL Module Configurations
- Connecting External Network Devices
- Fault-Tolerant Configurations

Understanding the General Rules

This section describes general rules for configuring an Ethernet network using fiber as the backbone medium. It also provides rules to ensure that your network configuration conforms to distance limitations imposed by Ethernet and networking equipment. Use these guidelines for building your network.

Refer to the sections that follow for specific rules for:

- Determining maximum 10BASE-FL fiber link distances
- Connecting various horizontal media types (10BASE-FL, 10BASE-T) to a 10BASE-FL backbone
- Examples of recommended fault-tolerant configurations

Basic Network Rules

This section outlines the basic network rules and the 3Com recommendations for these rules. For additional hardware-specific information on this module, refer to Appendix A.

Table 2-1 outlines the seven basic rules to keep in mind when you construct your network.

Table 2-1. Seven Basic Network Rules

Rule	Definition	Recommendations/Notes
1	If possible, use 10BASE-FB as the backbone medium.	Use 62.5 micron cable to conform with the IEEE 10BASE-F and upcoming ANSI FDDI standards.
		Use ST-type connectors.

Table 2-1. Seven Basic Network Rules (Continued)

Rule	Definition	Recommendations/Notes
2	Wire the backbone in a star topology to isolate faults.	Make sure to lay extra fiber cables. The extra cost is small and you will find you need them as your network grows.
		The star topology conforms to FDDI wiring as well -- just makesure to run at least two fiber strands to every backbone connection.
3	The maximum Fiber Ethernet network diameter is 4200 meters of fiber cable.	The 4200 meters is the maximum distance between any two transceivers on the network.
		The 4200 meters *does not include* the transceiver cable (that is, drop or patch cable) that connects a device with an external transceiver. Transceiver cables can extend up to 50 meters. Thus, total network diameter can be as much as 4300 meters (4200 m + 2 * 50 m) between any two nodes.
4	Certain LAN devices on the network shrink the maximum Fiber Ethernet network diameter to less than 4200 meters.	Many LAN products delay the signal that goes through them. This is known as *equivalent distance*. Every microsecond delay reduces the maximum link distance. In fact, every microsecond delay shrinks the network diameter by approximately 200 meters of fiber cable. Table 2-2 lists the Equivalent Distances for other 3Com products.

Table 2-1. Seven Basic Network Rules (Continued)

Rule	Definition	Recommendations/Notes
5	Assume that one meter of coaxial or twisted pair is equal to one meter of fiber cable.	This is a conservative rule of thumb. For example, the actual equivalence is about 1.1 meters of coaxial for every meter of fiber. For simplicity, assume one meter.
6	The fiber link distances must not exceed the limits imposed by the optical power budget.	In general, on 62.5 micron cable, you can go up to 4000 meters point-to-point using the ONcore or ONline Fiber Modules. If you have poor quality cable or cross many patch panels, you may have to sacrifice some distance.
		Some older Ethernet fiber optic products are less powerful than ONcore Fiber Module optics. So when connecting to these products, remember that the least powerful device determines the maximum point-to-point distance.
7	When in doubt, use a bridge.	If you are not certain if you have exceeded allowable network distances, use a bridge to extend the network.

LAN Equivalence

LAN equivalence is the sum of both the incoming and outgoing module port signals. Different modules, however, have different equivalent distances. Table 2-2 lists the LAN product equivalent distances.

Table 2-2. LAN Product Equivalent Distances

LAN Product	Equivalent Distance (meters)
ONcore or ONline Ethernet 10BASE-FB Modules	190
Incoming signal to fiber port	140
Outgoing signal from fiber port	50
ONcore or ONline Ethernet 10BASE-T Modules	585
Incoming signal to twisted pair port	420
Outgoing signal from twisted pair port	165
ONline Ethernet FOIRL Module	560
Incoming signal to fiber port	330
Outgoing signal from fiber port	230
ONline Ethernet Transceiver Module	0
ONline Ethernet BNC Module	900
Incoming signal to BNC port	450
Outgoing signal from BNC port	450
ONline Ethernet Repeater Module	800
Incoming signal to AUI port	600
Outgoing signal from AUI port	200
IEEE Repeater	800

Determining Maximum 10BASE-FL Link Distances

This section describes how to calculate the maximum allowable link distances between two 10BASE-FL ports.

To do this, you must know the following information:

- 10BASE-FL Module optical (link) power budget
- Fiber cable diameter (for example, 50 micron, 62.5 micron)
- Fiber cable light loss/km (for example, 3 dB loss/km)
- Number of patch panel connections between ports
- Number of splices on the link

The following tables assist you in obtaining this information:

- Table 2-3 - Outlines the optical power budget for the 10BASE-FL Module.
- Table 2-4 - Lists typical losses for various connector types.
- Table 2-5 - Lists typical losses for various fiber cables.

Calculating Maximum Link Distance

To calculate the maximum link distance allowed:

1. Determine the optical power budget for the 10BASE-FL port (Table 2-3).
2. Subtract the optical power loss due to patch panels and splices (Table 2-4) from the optical power budget for the 10BASE-FL port.
3. Subtract the dB loss/km rating of the fiber cable (Table 2-5) from the remainder of Step 2. If the result is greater than 0 dbm, the link distance is valid.

Determining Link Budget

As a network planner or installer, account for worst case losses through the optical connection, end-to-end, to ensure link integrity. The optical power budget represents a "worst case" assuming the transmitter is transmitting at the low end of its range.

Adhere to the IEEE 802.3 10BASE-FL specification which states that the minimum distance supported between two 10BASE-FL ports is 2 kilometers.

If the link between two 10BASE-FL ports is:

- Less than 2 kilometers and contains minimal losses (that is, only one splice or connector and typical fiber cable attenuation) you do *not* need to calculate the optical budget for the link.
- If you must exceed 2 kilometers, or if you have multiple splices in the cable, you must calculate the optical power budget.

Note: When connecting a 10BASE-FL product to an FOIRL product, do not exceed the 1 kilometer maximum distance defined by the 802.3 FOIRL specification. Because 10BASE-FL is backward compatible with FOIRL, you can make mixed 10BASE-FL/FOIRL connections. However, to interoperate 10BASE-FL and FOIRL equipment, observe the more limiting restrictions of the FOIRL specification.

Table 2-3 provides the Transmit Optical Power ranges and required Receiver Optical Power sensitivity levels for the 10BASE-FL Module.

Note: The values in Table 2-3 are peak power values. You determine average optical power by subtracting 3 dBm from the peak value. All of the examples provided in the pages that follow refer to peak optical power. Note that higher optical power is represented by a smaller negative number (for example, -12 dBm is greater than -20 dBm).

Table 2-3. 10BASE-FL Module Optical Power Budget

Cable Size Used (microns)	Transmit Power (dBm) (Peak)	Receive Power Range (dBm) (Peak)	Optical Power Budget (dB)	Link Loss Required (dB) (ONline to ONline)
50/125 NA 0.20	-16.5 ± 3.0	-8.0 to -29.5	10.0	None
62.5/125 NA 0.275	-12.0 ± 3.0	-8.0 to -29.5	14.5	None
85/125 NA 0.29	-9.0 ± 3.0	-8.0 to -29.5	17.5	>2.0 dB
100/140 NA 0.29	-6.5 ± 3.0	-8.0 to -29.5	20.0	>4.5 dB

Attenuation

It is possible for receivers to receive too much light when:

- ❑ Using 85/125 and 100/140 micron fiber cables
- ❑ Ports are close together on a link

In such cases, some attenuation is required to prevent this problem. This attenuation is usually covered by:

- A moderate link length
- The fiber optic connectors

Splicing

Many fiber optic installations employ the use of patch panels to manage expansion and topological changes. A typical patch panel consists of a set of female-to-female bulkhead barrel connectors used to connect male fiber connectors on both sides. The optical power loss through a patch panel includes two connectors and a bulkhead.

If a fiber optic cable breaks, the break is usually fixed by splicing the broken ends together. Use one of the following types of splicing:

- **Fusion** - A fusion splice usually offers lower power loss, but the fusion equipment is often bulky and costly.
- **Mechanical** - A mechanical splice can be conveniently used in the field when a fusion splice is not available. If a repair is made, make sure that the fiber cable still meets the power loss guidelines.

Table 2-4 shows the range of loss and the typical loss as a result of splice.

Table 2-4. Connector and Splice Insertion Loss

Connector Type	Range of Loss Per Pair (dB)	Typical Loss (dB)
SMA Patch Panel	1.0 to 3.0	2.0
ST or FC Patch Panel	0.1 to 0.75	0.5
Splice Type	**Range of Loss (dB)**	**Typical Loss (dB)**
Fusion	0.01 to 0.1	0.05
Mechanical	0.2 to 1.0	0.5

Optical Fiber Loss

Even though fiber optic cable can carry light signals over a long distance, optical power loss is a significant factor. Check your cable manufacturer's rating of the loss characteristic of your fiber cable to determine the actual loss.

Table 2-5 shows typical power losses in fiber optic cables.

Table 2-5. Typical Fiber Loss Characteristics

Fiber Type @ 850 nM	Loss (dB/km)	Typical Loss (dB/km)
50/125 micron	3 to 5	3.75
62.5/125 micron	3 to 5	3.75
85/125 micron	3 to 6	4.0
100/140 micron	3 to 6	5.0

Maximum Link Distance Calculation

The following examples use the information provided in the previous pages to calculate the maximum allowable fiber optic link distance between two ports.

Example: Fiber Link With Mechanical Splice

In the following example, two ONline Concentrators are connected using fiber. If we use 62.5/125 fiber cable, the optical power budget according to Table 2-3 is 14.5 dB. Figure 2-1 shows an example of a 2000 meter fiber link with a mechanical splice.

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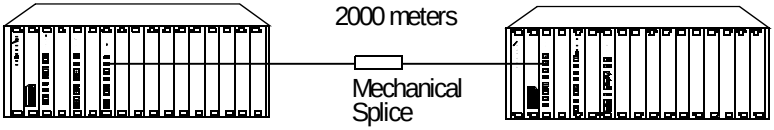

2.0 km Fiber Cable = 10 dB loss worst case using 5 dB/km loss fiber cable
1 Mechanical Splice = 1 dB loss worst case
Path Loss = 11 dB

Figure 2-1. 2000 Meter Fiber Link With Mechanical Splice

The total path loss is 11 dB. Because the overall power budget is 14.5 dB, this leaves 3.5 dB to spare, so the link can be made.

Ensure you do not overdrive a receiver (that is, the received optical power level is not greater than the maximum receive sensitivity level of the fiber connector). In this case, the maximum possible transmit power, -12 dB + 3.0 dB = -9 dB (see Table 2-3). The power loss over the link is 11 dB. This means that the power level of the signal will drop to -20.0 dB by the time it reaches the receiver. Because the maximum receiver sensitivity is -8.0 dB, there is no overdrive problem.

Example: Fiber Link Through Patch Panels

Figure 2-2 illustrates two ONline Concentrators are separated by 1700 meters of fiber cable with two patch panels in between. If we use 50/125 fiber cable, the optical power budget according to Table 2-3 is 10.0 dB.

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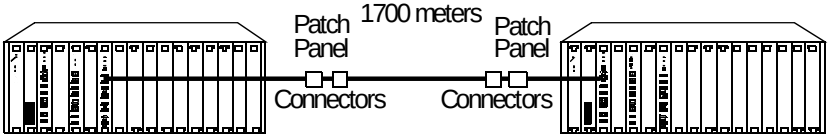

1.7 Km Fiber Cable = 8.5 dB loss worst case using 5 dB/Km loss fiber cable
Two ST Patch Panel = 1.5 dB loss worst case
Path Loss = 10.0 dB

Figure 2-2. 1700 Meter Fiber Link Through Two Patch Panels

Total path loss in this example is 10 dB. Because the overall optical power budget for 50/125 cable is 10.0 dB, this leaves 0 dB to spare.

In addition, the received optical power is on the outer edge of the specification. As defined in Table 2-3, the peak received power range for 50/125 cable is -29.5 dB. Adding the path loss of 10.0 dB to -19.5 dB equals -29.5.

This may cause the 10BASE-FL Module Port Status LED to signal a no light condition. If a no light condition occurs, you must reduce the optical path loss by shortening the cable or by eliminating some of the optical connectors.

Choosing a Network Backbone Cabling Structure

Because of fiber's long-distance capabilities and immunity to noise, 3Com strongly recommends using fiber as the backbone. You can choose between two fundamental configuration topologies when connecting your network backbone using 10BASE-FL Modules in the ONline System Concentrator:

- ❑ Star Configuration
- ❑ Serial Configuration

Star Configuration

Wire your network in a star configuration using an ONline System Concentrator as the central point in the network. Wiring in a star topology configuration has two major benefits:

- ❑ Faults in the cable plant affect only a piece of the network
- ❑ You can easily expand the size of your network

Figure 2-3 shows an example of a star-wired configuration

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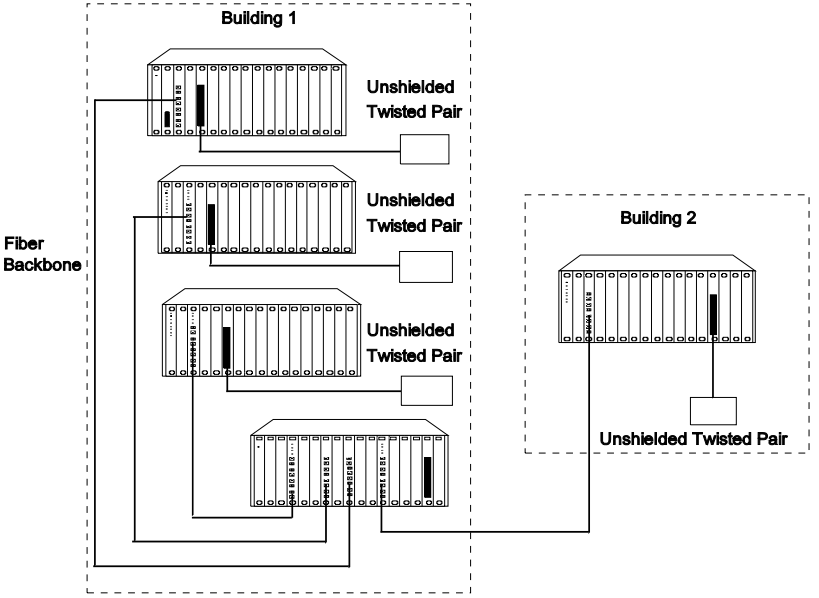

Figure 2-3. Star-Wiring Configuration

Serial Configuration

Use a serial configuration (Figure 2-4) for smaller diameter networks that are not expected to grow. Serial configurations reduce the overall network diameter (by 560 meters for each concentrator in any path)

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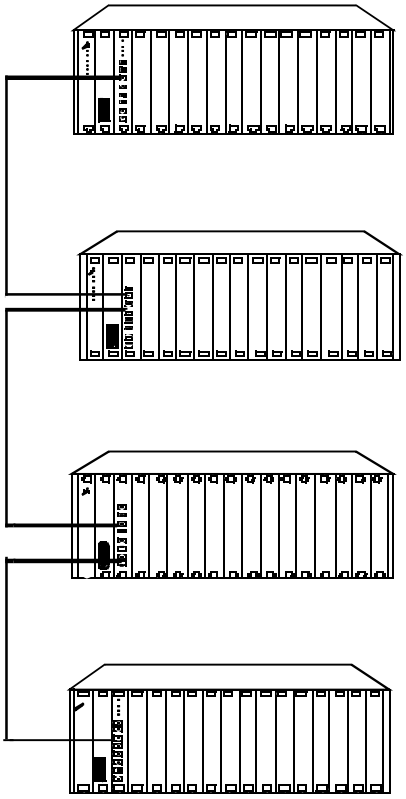

Figure 2-4. Serial Configuration Using 10BASE-FL Modules

10BASE-FL Module Configurations

The theoretical maximum diameter of an all fiber Ethernet network is limited to 4.2 km as defined by the 51.2 µsec slottime that is specified for the round trip-delay budget set by the IEEE 802.3 CSMA/CD protocol. (Thus, point-to-point link distances are limited to a maximum of 4.2 km.) This section describes how to define total network size based on the limits of IEEE 802.3 collision detection.

This section describes the following scenarios:

- 10BASE-FL Backbone, 10BASE-FL to-the-Desk
- 10BASE-FL Backbone, Unshielded Twisted Pair to-the-Desk
- 10BASE-FB Backbone, 10BASE-FL to-the-Desk

10BASE-FL Backbone, 10BASE-FL to-the-Desk

When designing an all-10BASE-FL network, keep the following rules in mind:

1. Limit the longest ideal path between any two network stations to 4200 meters due to the IEEE slottime of 51.2 µsec.
2. Limit the length of an 10BASE-FL segment by the optical budget of the link and the overall size of the network. The 802.3 10BASE-FL specification sets 10BASE-FL link distances to 2 km. However, you can generally extend the length if you compute the optical budget and take end-to-end timing into consideration.
3. Each 10BASE-FL Module in a serial path between the two transceivers reduces the maximum cable distance between them by 560 meters (1836 feet). To be accurate, the equivalent fiber distance is:
   - 330 meters for signals that externally enter a 10BASE-FL Module port and go through the backplane
   - 230 meters for signals that internally enter a 10BASE-FL Module using the ONline Concentrator backplane
   - 560 meters for signals that externally enter and then exit the same 10BASE-FL Module

   For simplicity, use 560 meters per 10BASE-FL Module in the path, regardless of the signal's direction, when calculating fiber equivalent distances. Note, however, that this limits the network diameter to less than the maximum size.

4. Each 10BASE-FL Module counts as one half of a repeater. The 802.3 specification limits the number of repeaters between any two network stations to 4. This restricts the number of serially-connected 10BASE-FL Modules to a maximum of 8.

Note: The Ethernet 4-repeater rule limits the number of repeaters between any two transceivers to 4. In general, this restricts most vendor configurations to a maximum of 4 concentrators connected in series.

5. Rule number 1 does not include AUI cables of up to 50 meters. Thus, the total network diameter between 10BASE-FL Ethernet nodes can be 3740 meters (4200 m - 560 m + 50 m + 50 m = 3740 m) through a single concentrator.

Figure 2-5 shows an example of an all-10BASE-FL network

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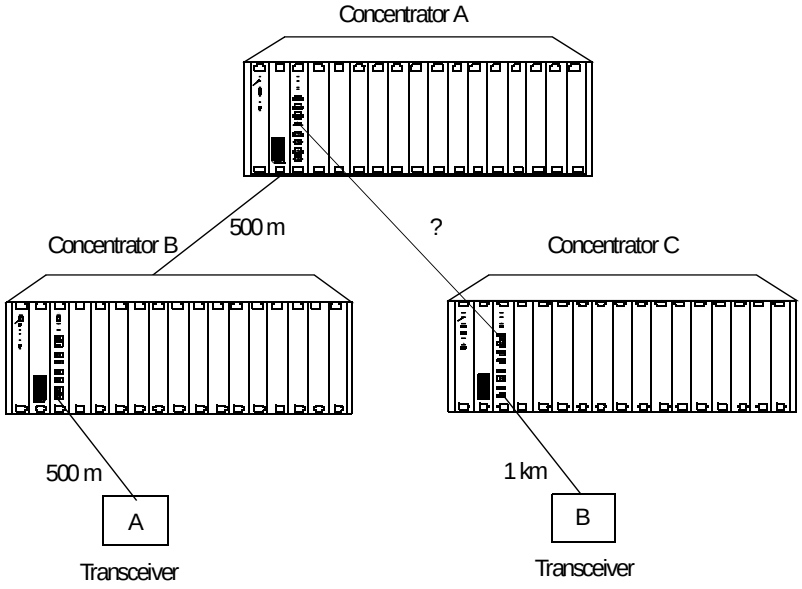

Figure 2-5. All-10BASE-FL Network with 3 Concentrators

Network Distance Calculation Examples

The following examples demonstrate how to calculate network distances for various all-10BASE-FL networks.

Example: A Network with 3 Concentrators

Refer to Figure 2-5, which shows a network with 3 concentrators.

To determine the maximum allowable link distance betweenConcentrators A and C:

1. Begin with 4200 meters (Ethernet Rule 3).
2. Subtract the fiber equivalent of the three concentrators with 10BASE-FL Modules that occur on the path between the two transceivers:

   3 * 560 meters for each 10BASE-FL module = 1680 meters (Ethernet Rule 4)
3. Subtract the known amount of fiber cable between the two transceivers:

   500 m + 500 m + 1 km = 2 km (Ethernet Rule 5)
4. The remainder is the maximum allowable distance of the link between concentrators A and C:

   4200 m - 1680 m - 2000 m = 520 meters
5. Verify that the optical power budget is able to drive all of the link distances in the example. Because all link distances are only 1 km or less, and do not have any splices, this is not a problem.

Example: A Network with 6 Concentrators

Six concentrators are connected in Figure 2-6. Use this example to determine if the distances between transceivers are all within the 4200 meter maximum network diameter restriction for Ethernet networks.

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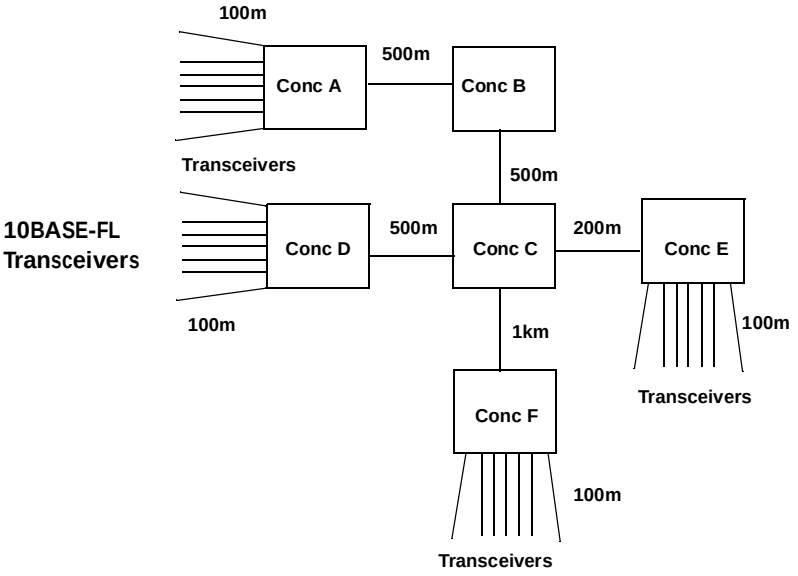

Note: All 10BASE-FL Transceiver connections to concentrators (each populated with 10BASE-FL Modules) are 100 meters of fiber.

Figure 2-6. Network with 6 Concentrators

In this example, the path between transceivers attaching Concentrators A and F has the greatest fiber equivalent distance of 4440 meters (2200 + (4 * 560) = 4440). Because this distance exceeds the maximum of 4200 meters, this configuration is illegal and results in improper network operation.

Because it is not always obvious which path between transceivers has the greatest fiber equivalent distance, use Table 2-6 to help you determine the equivalent distances.

Table 2-6. Fiber Equivalent Distances Between Transceivers

Path	Total Fiber Distance Between Transceivers (meters)	Number of Concentrators (10BASE-FL Modules) Between Transceivers	Equivalent Fiber Distance of Concentrator (meters)	Total Fiber Equivalent Distance (meters)
A-D	1700	4	2240	3940
A-E	1400	4	2240	3640
A-F	2200	4	2240	4440
D-E	900	3	1680	2580
D-F	1700	3	1680	3380
F-E	1400	3	1680	3080

10BASE-FL Backbone, Unshielded Twisted Pair to-the-Desk

Designing a network with unshielded twisted pair cabling to-the-desk is similar to an all-10BASE-FL network because the cabling is star-wired in both cases (see Figure 2-7). See the section in this chapter "10BASE-FL Backbone, 10BASE-FL to-the-Desk" for more information on all-10BASE-FL networks.

Be aware of the following two additional rules:

- Ensure that there are no more than eight 10BASE-FL Modules (and/or 10BASE-T Modules) in the path between any two transceivers due to Ethernet's 4-repeater rule (each 10BASE-FL and 10BASE-T Module counts as a 1/2 repeater). If you have more than eight modules serially connected, you must add a bridge.

- 10BASE-T Modules have an equivalent fiber distance (see Ethernet Rule 4) as follows:
  - 420 meters for signals that externally enter a 10BASE-T Module port
  - 165 meters for signals that internally enter a 10BASE-T Module via the ONline Concentrator backplane

For each pair of 10BASE-T Modules that a signal goes through, there is a fiber equivalent distance of 585 meters (420 m + 165 m =585 m). In addition, if a signal makes a roundtrip through a 10BASE-T Module (that is, enters a 10BASE-T port externally and exits through another port on the same 10BASE-T Module), that counts as 585 meters of fiber equivalent distance.

Example: Sample Configuration Distance Calculation

Use the following example to determine if the 10BASE-T Transceivers in Figure 2-7 are within legal Ethernet limits. Identify the two transceivers that are likely to be the greatest fiber equivalent apart in Figure 2-7. In this case, they are 10BASE-T Transceivers A and B.

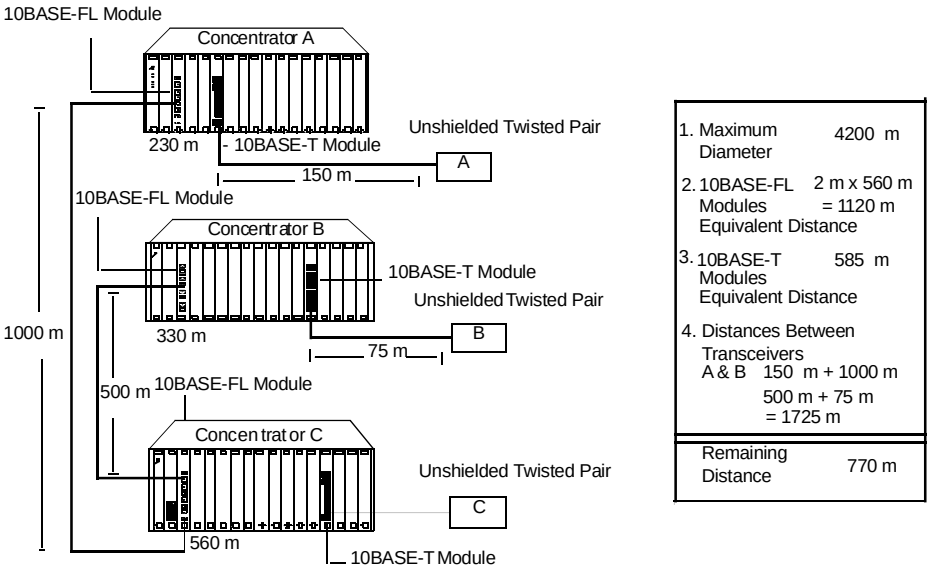

Figure 2-7. Sample Configuration Distance Calculation

To make the configuration in Figure 2-7 work, ensure the fiber equivalent distance between transceiver A and transceiver B is less than 4200 meters. To determine if the network configuration is legal:

1. Use 4200 meters as the maximum network diameter for a pure fiber network as defined by the 802.3 specification.

2. Subtract the equivalent fiber distance for each intervening ONline Concentrator with a 10BASE-FL Module in the path. Figure 2-7 has three concentrators between the two 10BASE-T Transceivers A and B (Rule 4). The signal transverses three 10BASE-FL Modules from a delay perspective (230 m on Concentrator A + 560 m on Concentrator C + 330 m on Concentrator B = 1120 m).

3. Subtract the fiber equivalent distance for the two 10BASE-T Modules in Concentrators A and B between the two 10BASE-T Transceivers A and B (Rule 4).

- ❑ Incoming signal from Transceiver A to the 10BASE-T Module = 420 m.
- ❑ Outgoing signal from the 10BASE-T Module to Transceiver B = 165 m (420 m + 165 m = 585 m).

4. Subtract all cable lengths between the two transceivers (calculate copper length the same way you do for fiber). In this example, the total cable distance equals 1725 meters.

   If the result from step 4 is greater than zero, the configuration is within legal Ethernet limits (Rule 5).

The calculation in this example shows that 770 meters remain for expansion in this configuration. Therefore, this configuration is legal.

10BASE-FB Fiber Backbone, 10BASE-FL to-the-Desk

Use the information in this section when designing your network using 10BASE-FB fiber as the network backbone and 10BASE-FL Modules for to-the-desk connectivity. This section assumes that the backbone is comprised of 3Com fiber products, such as the ONline Ethernet Fiber Module or ONline Ethernet 10BASE-FB Module. 3Com Ethernet Fiber modules and transceivers conform to the IEEE 10BASE-F standard.

The rules that apply to building this type of network have been covered in the previous sections. The following two additional rules apply when using ONline Ethernet Fiber Modules:

1. The equivalent fiber distance for the Fiber Module and the Port-Switching Fiber Module is:
   - 140 meters for signals that externally enter the module
   - 50 meters for signals that internally enter the module through the ONline Concentrator backplane

Therefore, for each pair of ONline Fiber Modules that a signal passes through, there is a fiber equivalent distance of 190 meters (140 m + 50 m = 190 m). In addition, a signal making a round trip through the module (that is, entering a port externally and exiting through another port on the same module) counts as 190 meters of fiber equivalent distance.

2. Do not count the ONline Ethernet Fiber Module and the ONline Ethernet Port-Switching Fiber Module as repeaters when determining the maximum number of repeaters in your network. These are repeater-less devices.

Example: Fiber Backbone, 10BASE-FL to-the-Desk

Use the following example to determine if the 10BASE-FL transceivers are within legal Ethernet limits. First identify the two transceivers that are likely to be the greatest distance apart in Figure 2-8. In this case, they are 10BASE-FL transceivers A and B

.

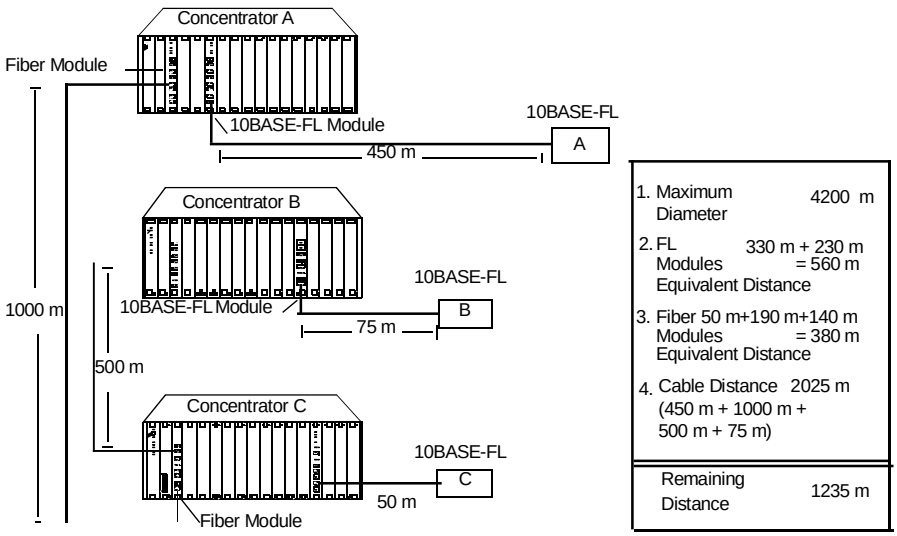

Figure 2-8. Sample Fiber Backbone, 10BASE-FL to-the-Desk Configuration

To determine if the network configuration in Figure 2-8 is legal:

1. Use 4200 meters as the maximum network diameter as defined by the 802.3 specification.

2. Subtract the equivalent fiber distance for each 10BASE-FL Module in the signal path between Transceivers A and B. This equals 330 meters for Concentrator A and 230 meters for Concentrator B (560 meters total).

3. Subtract the equivalent fiber distance for each Fiber or Port-Switching Fiber Module in the signal path. This equals 50 meters for Concentrator A, 190 meters for Concentrator C, and 140 meters for Concentrator B (380 meters total).

4. Subtract all fiber cable lengths between the transceivers (450 m + 1000 m + 500 m + 75 m = 2025 meters).

   Because the final remaining distance is greater than zero (1235 meters), the network configuration is legal.

Connecting External Network Devices

When connecting Thick or Thin Ethernet segments to an ONline network, you can use an:

- ONline Ethernet Repeater Module
- ONline Ethernet Bridge Module
- External repeater or bridge
- An IEEE Repeater or ONline Repeater Module each have an equivalent fiber distance of 800 meters

Example: Connecting a Thin Ethernet (10BASE2) Segment

Figure 2-9 shows a typical Thin Ethernet segment connected to an ONline Concentrator through an IEEE 802.3 Repeater

.

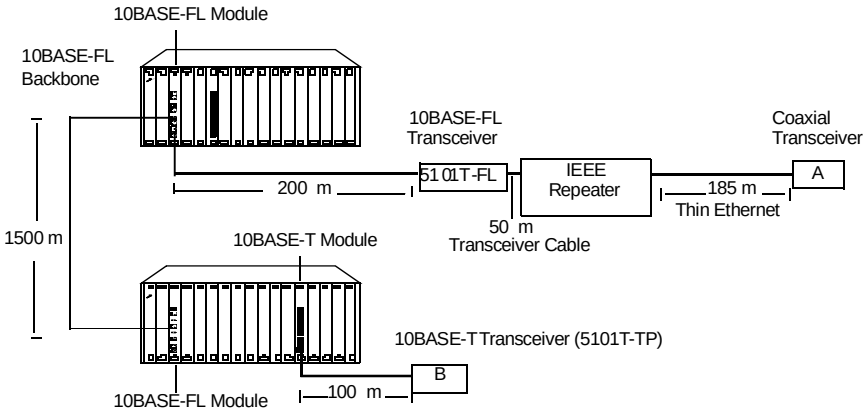

Figure 2-9. Thin Ethernet Segment Connecting to ONline Using an IEEE Repeater

To determine if the configuration in Figure 2-9 meets Ethernet distance limitations for transceivers A and B:

1. Use 4200 meters as the maximum network diameter as defined by the 802.3 specification.

2. Subtract the fiber equivalent distance of 420 m for the signal externally entering the 10BASE-T Module from Transceiver B and 230 meters for the signal exiting the 10BASE-FL Module within the same concentrator. (Ethernet Rule 4)

3. Subtract the fiber equivalent distance of 560 meters for the signal externally entering the 10BASE-FL Module in the top concentrator, and internally exiting a different port on the same 10BASE-FL Module.

4. Subtract the fiber equivalent distance (800 m) of the IEEE Repeater. (Ethernet Rule 4)

Note: In the reverse direction, a signal originating at Transceiver A loses 165 m of fiber equivalent distance when it exits the 10BASE-T Module to which Transceiver B is connected and 330 meters for the signal entering the 10BASE-FL Module in the bottom concentrator. The overall fiber equivalence of the path is greater for signals going from Transceiver B to A, however, the B to A fiber equivalence determines whether the link meets the 4200 m Ethernet link maximum.

5. Subtract the sum of intervening cable lengths:

   185 m + 50 m + 200 m + 1500 m + 100 m = 2035 m

6. The remainder is:

   4200 m - 420 m - 230 m - 560 m - 800 m - 2035 m = 155 m

   Because the remaining value is greater than zero, the configuration in Figure 2-9 is legal.

Fault-Tolerant Configurations

This section contains descriptions of the redundancy features built into the ONline 10BASE-FL Module. You can implement link redundancy between concentrators using the port redundancy switch settings on the 10BASE-FL Module.

This section contains the following topics:

- Configuring Ports for Fault Tolerance
- Implementing Backbone Cable Plant Fault Tolerance
- Implementing Total Backbone Fault Tolerance

Configuring Ports for Fault Tolerance

You can configure ports 1 through 4 on the 10BASE-FL Module in one of five ways:

- **Normal Configuration** - Ports 1 through 4 operate as independent cable ports.
- **Standard Redundant Configuration** - In this configuration:
  - Port 1 acts as the primary port and port 2 as the backup for 1.
  - Port 3 acts as the primary port and port 4 as the backup for 3.
- **Flexible Redundant Configuration** - You can arbitrarily assign primary and backup ports to any pair of ports. You can configure this mode only through a network management module.
- **Normal and Redundant Configuration** - You can enable redundancy between one set of ports and configure the remaining two ports to operate as independent ports.

- **Remote Failure Signaling Configuration** - If redundancy is enabled at the other end of the fiber link, you *must* enable remote failure signaling for all connecting 10BASE-FL Module ports.

Implementing Backbone Cable Plant Fault Tolerance

You can enable redundancy between two ports on the 10BASE-FL Module using either:

- Network management module commands
- A dip switch

This section describes:

- Setting Redundancy
- Remote Failure Signalling

Setting Redundancy

When you enable redundancy between two ports, the ports are automatically enabled. Port 1 (or 3) then becomes the primary link and port 2 (or 4) the redundant link. For maximum cable plant fault tolerance, connect both the primary and backup ports back to the central concentrator (Figure 2-10). This configuration allows the backup port to automatically take over if the primary link fails.

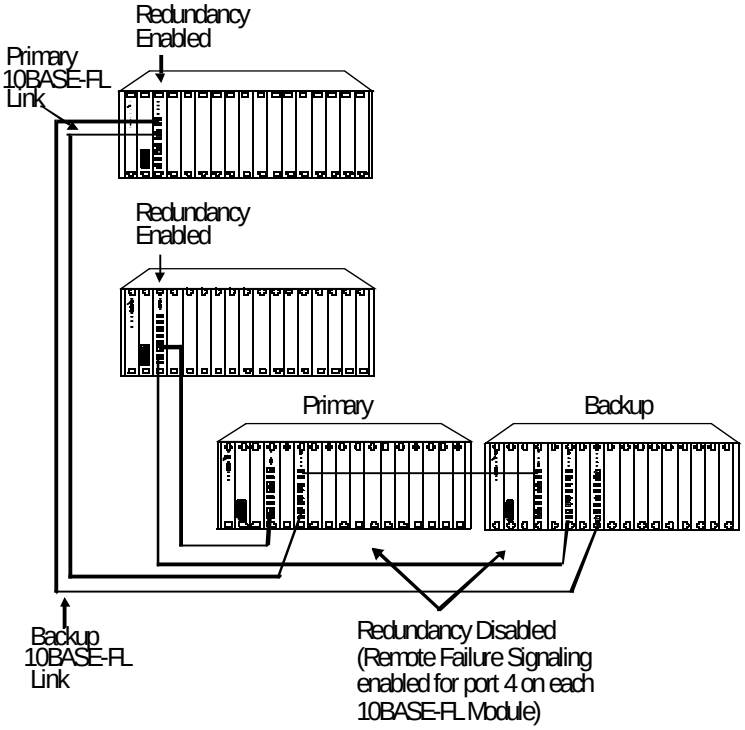

Figure 2-10. Redundant Fiber Backbone Configuration

Note: Always enable redundancy in the lower level concentrators (those connecting to the central concentrators in the star-wired topology).

The primary port passes data. The backup port does not pass any data in either direction, but the link is monitored for any failures (the Port Status LED indicates any problems).

Remote Failure Signaling

In any redundant link path, you can designate (that is, activate) only one end as a redundant port pair (1-2 or 3-4). You must enable remote failure signaling (RFS) if ports are connected to fiber with redundancy enabled at the other end. If you enable ports at both ends as redundant, or if you do not enable remote failure signaling at the distant end, improper operation of the redundant switchover mechanism occurs (see Figure 2-11).

If the primary link experiences a local or remote fault, the backup link activates and the primary ports disconnect (that is, they do not pass data to and from the concentrator). Once the switchover to backup occurs, the redundancy status indicators blink at the redundant module end. However, primary port diagnostics continue to operate. If the fault clears, the primary port is re-enabled.

Each redundancy status LED (located beneath the Activity LEDs):

- **Is off** - If you disable redundancy.
- **Is on** - If you enable redundancy and both ports are operational.
- **Blinks** - If a switchover occurs due to a link failure.

Implementing Total Backbone Fault Tolerance

You can add a backup ONline System Concentrator to provide total backbone fault tolerance and link redundancy for your backbone network. As shown in Figure 2-11, if the primary concentrator or any primary links fail, the backup concentrator takes over. In this configuration:

- One port on the 10BASE-FL Modules connects to the primary concentrator.
- The other port connects to the backup concentrator.

You must also have a direct connection between the two concentrators

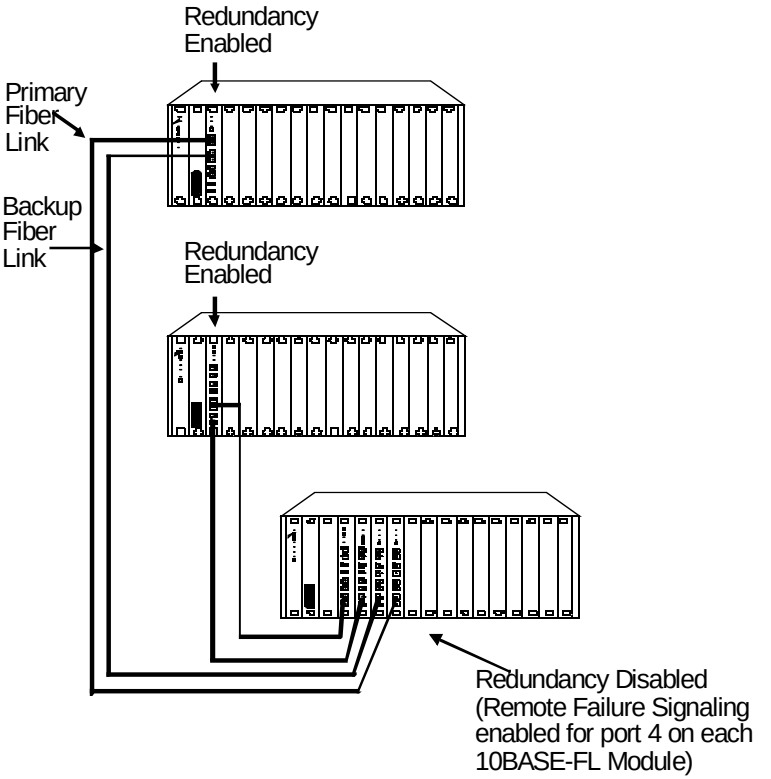

Figure 2-11. Total Backbone Fault-Tolerant Configuration

Example: Network with Three Concentrators and a Fourth Concentrator in Full Redundancy Configuration

In the following example, three concentrators are active.

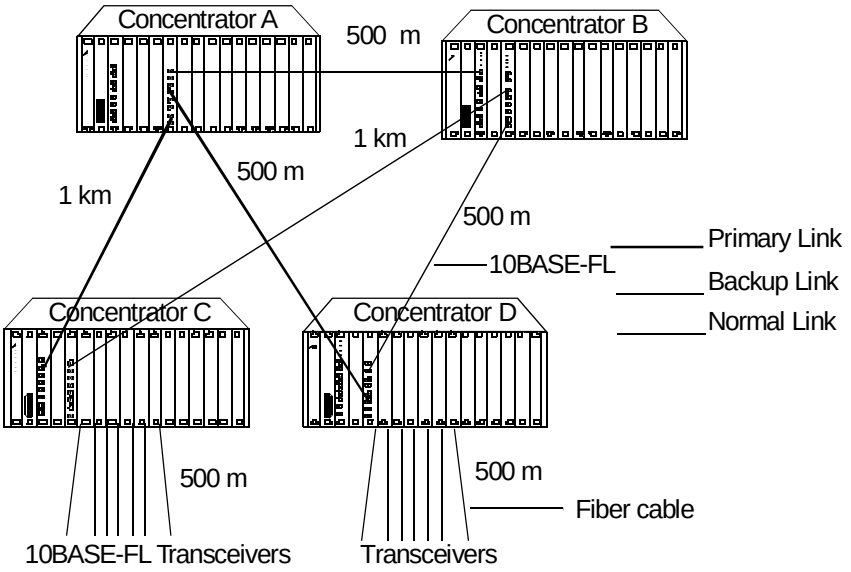

Figure 2-12. Network With 3 Concentrators

Concentrator B is a redundant concentrator for Concentrator A. The fiber equivalent distance between transceivers attached to Concentrators C and D is:

3 * 560 m + 500 m + 1000 m + 500 m + 500 m = 4180 meters

Because the sum is less than 4200 meters, the configuration is legal.

In Figure 2-12, if the main link from Concentrator A to Concentrator C faults, the signal path enabled through redundancy includes Concentrator B. By adding Concentrator B, the fiber equivalent distance becomes too great and the network cannot work because the path between Concentrators C and D is C-B-A-D:

4 * 560 + 500 m + 1000 m + 500 m + 500 m + 500 m = 5240 meters

Because the sum is greater than 4200 meters, this configuration is not legal. When designing a redundant network, be sure to consider the backup route distance.

3 Installing and Operating the Module

This chapter describes the installation procedures for the ONline Ethernet 10BASE-FL Module.

For your convenience, a quick reference installation chart is included. This chapter includes the following sections:

- ❑ Precautionary Procedures
- ❑ Unpacking Procedures
- ❑ Quick Installation
- ❑ Setting the Dip Switches
- ❑ Installing the Module
- ❑ Configuring the Module
- ❑ Showing Module Configuration
- ❑ Monitoring the Front Panel
- ❑ Verifying the LEDs and Network Assignments

Note: Read the precautionary procedures before unpacking the module.

Precautionary Procedures

Electrostatic discharge (ESD) can damage static-sensitive devices on circuit boards. Follow these precautions when you handle the 10BASE-FL Module:

- ❑ Do not remove the board from its anti-static shielding bag until you are ready to inspect it.
- ❑ Handle the board by the faceplate only.
- ❑ Use proper grounding techniques when you install the 10BASE-FL Module. These techniques include:
  - Using a foot strap and grounded mat or wearing a grounded static discharge wrist strap.
  - Touching the grounded rack or other source of ground just before you handle the 10BASE-FL Module.

Unpacking Procedures

When unpacking your 10BASE-FL Module:

1. Verify that the 10BASE-FL Module is the correct model by matching the model number listed on the side of the shipping carton to the model number you ordered (Model Number 5104M-FL1).

   Note that the product model number printed on the shipping box differs from the model number on the product. The model number on the shipping box contains the prefix '3C9'.

2. Remove the 10BASE-FL Module from the shipping carton.
3. Remove the 10BASE-FL Module from the anti-static shielding bag and inspect the module for damage. If the module appears to be damaged, replace it in the anti-static shielding bag, return it to the shipping carton, and contact your local supplier.

4. Keep the carton and anti-static bag in which your module was shipped for repackaging the module for storage or shipment.

5. Record the serial number of your 10BASE-FL Module. A log and other information specific to your modules is included in the *ONline System Concentrator Installation and Operation Guide,* Appendix B, Slot Usage Chart.

Quick Installation

Table 3-1 outlines the steps for installing your module.

Table 3-1. Quick Installation Procedures

Step	Procedure	Section Title
1.	Verify that your network complies with basic rules for network design.	Chapter 2, Designing and Expanding the Network
2.	Unpack the module.	Unpacking Procedures
3.	If you *do not* have a management module installed in the concentrator, configure the dip switch settings to your specifications.	Setting the Dip Switches
4.	Insert the module into a blank slot in the concentrator and tighten the faceplate screws.	Installing the Module
5.	Establish connections from the 10BASE-FLModuletoanother10BASE-FL Module or 10BASE-FL Transceiver using the appropriate connectors and cabling.	Installing the Module

Table 3-1. Quick Installation Procedures (Continued)

Step	Procedure	Section Title
6.	If you have a management module installed in the concentrator, configure the module using the management commands.	Configuring the Module
7.	Verify LED status for normal operation.	Verifying LED and NetworkAssignments

Setting the Dip Switches

The 10BASE-FL Module has two 8-position dip switches (SW1 and SW2) located on the rear of the board. Figure 3-1 shows the location and default settings of the SW1 and SW2 dip switches. You may need to reconfigure one or more of these switches depending on your configuration requirements.

The dip switch settings for the 10BASE-FL Module are ignored if an appropriate ONline management module is installed in the concentrator. For this reason, use the management commands (rather than the dip switches) to configure the 10BASE-FL Module. If you have an installed Ethernet Management Module (EMM) at Version 4.01 or higher, install the module first and then refer to the Configuring the Module section in this chapter for more information.

The remainder of this section describes:

- Setting Dip Switch SW1
- Setting Dip Switch SW2

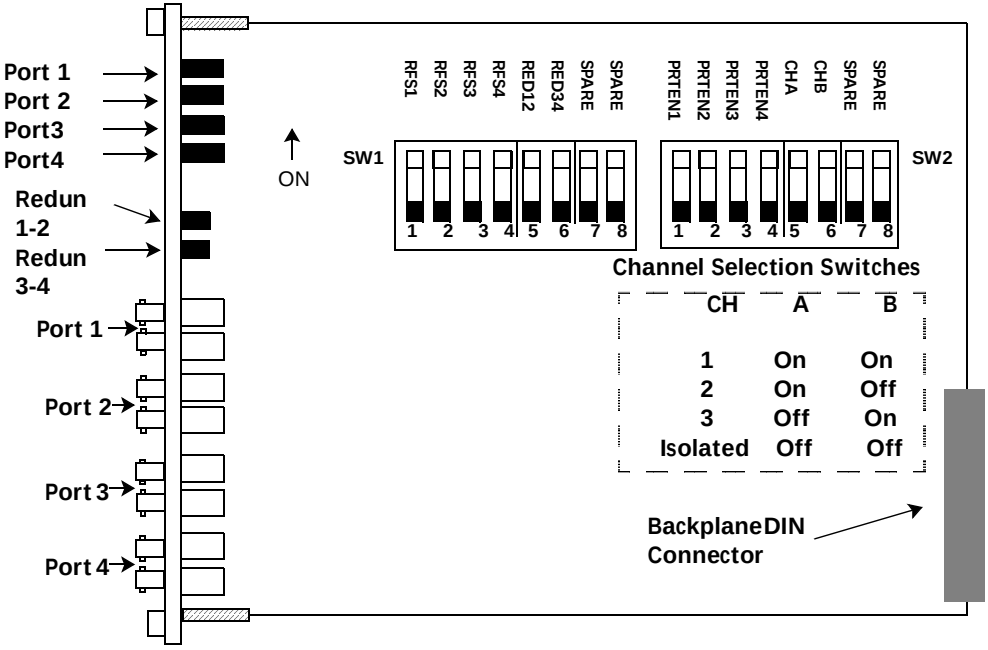

Figure 3-1. 10BASE-FL Module Dip Switch Locations

Setting Dip Switch SW1

The SW1 dip switch on the 10BASE-FL Module contains 8 dip switches. Switches 7 and 8 are not functional. The remaining switches allow you to:

- ❑ Enable or disable redundancy between ports 1 and 2 or 3 and 4
- ❑ Enable remote failure signaling for each port

Table 3-2 lists the functions and settings for switch SW1. For a definition of each dip switch function, refer to the Configuring the Module section.

Table 3-2. Dip Switch SW1 Settings

Switch	Label	Function	Factory Default	Switch Setting Off On
1	RFS1	Enable remote failure signaling on port 1	disable	disable
2	RFS2	Enable remote failure signaling on port 2	disable	disable
3	RFS3	Enable remote failure signaling on port 3	disable	disable
4	RFS4	Enable remote failure signaling on port 4	disable	disable
5	RED12	Enable/disable redundancy between ports 1 and 2	disable	disable
6	RED34	Enable/disable redundancy between ports 3 and 4	disable	disable
7 and 8	SPARE	Not used		

Setting Dip Switch SW2

The SW2 dip switch on the 10BASE-FL Module contains 8 dip switches. Switches 7 and 8 are not functional. The remaining switches allow you to:

- ❑ Enable or disable each of the ports
- ❑ Assign the module to a channel

Table 3-3 lists the functions and settings for switches 1 through 4. For a definition of each dip switch function, refer to the Configuring the Module section in this chapter..

Table 3-3. Dip Switch SW2 Settings for Switches 1 to 4

Switch	Function	Factory Default
1	Enable/Disable port 1	Enable (On)
2	Enable/Disable port 2	Enable (On)
3	Enable/Disable port 3	Enable (On)
4	Enable/Disable port 4	Enable (On)

Table 3-4 lists the functions and settings for switches 5 and 6. For a definition of each dip switch function, refer to the Configuring the Module section in this chapter.

Table 3-4. Dip Switch SW2 Settings for Switches 5 and 6

	CHA	CHB	Channel Selection
Switch Settings	On	On	1 (factory default)
	On	Off	2
	Off	On	3
	Off	Off	Isolated (module operates independent of any backplane channel)

Installing the Module

You do not need to power down the ONline System Concentrator to install the 10BASE-FL Module. You can insert the module while the concentrator is operating (this is called a *hot swap*).

To install the module:

1. Do one of the following:

   - If you do not have a management module installed in the concentrator, set the dip switches on the board (if different from the default settings). After you complete the installation procedure, proceed to the Monitoring the Front Panel section to verify the installation.

   - If you have a management module installed in the concentrator, complete this installation procedure and then configure the module using the commands as described in the Configuring the Module section.

2. Locate a blank slot in the concentrator. If there is no blank slot, remove a blank panel on the concentrator to expose a slot for the 10BASE-FL Module.

3. Insert the module into the board guides at the top and bottom of the slot and slide it into the concentrator. Make sure that the connector is well seated into the backplane of the concentrator.

Figure 3-2 shows the installation of the 10BASE-FL Module

.

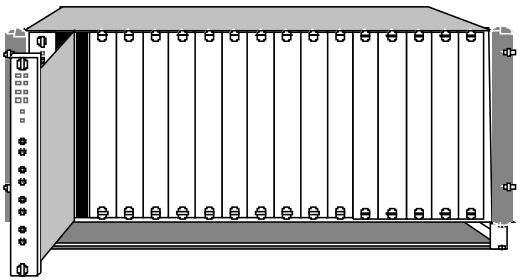

Figure 3-2. Installing the 10BASE-FL Module

4. Fasten the spring-loaded screws on the front of the 10BASE-FL Module faceplate to the concentrator using your fingers (do not overtighten).

5. Remove the plastic fiber optic dust covers from the cable ports. Keep unused cable ports capped to keep the optics clean.

6. Attach the fiber cables to the fiber ports on the front of the 10BASE-FL Module as shown in Figure 3-3.

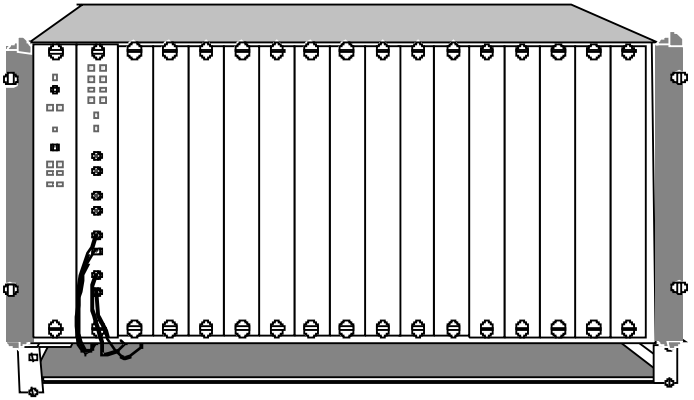

Figure 3-3. 10BASE-FL Module Connection

7. Make sure that the transmit and receive cables are:

   - ❑ Clearly marked or color coded.
   - ❑ Connected to the appropriate ports on the 10BASE-FL Module.
   - ❑ Properly cleaned with an appropriate fiber optic cleaning solution before installation.

Note: Do not exceed the bend radius for the fiber cable when directing the cables under the concentrator. Refer to the cable manufacturer's specifications for minimum bend radius.

8. Attach the other ends of the cables to either:

   - ❑ Another ONline 10BASE-FL Module.
   - ❑ An ONline 10BASE-FL Transceiver.

Make sure that the transmit fiber at one end always connects to a receive port at the other end.

Caution: Do *not* connect the 10BASE-FL Module to an ONline Ethernet Fiber Module, to a 10BASE-FB module, or to any other module or transceiver that is not FOIRL-compatible or 10BASE-FL-compliant. These illegal connections may cause network failure.

Configuring the Module

The ONline management modules can configure the following settings on the 10BASE-FL Module:

- ❑ Enable/disable any port on the module
- ❑ Set the module to a network
- ❑ Enable redundancy between two ports
- ❑ Enable remote failure signaling for any port

The following ONline management modules provide network management capabilities for the ONline System Concentrator and its modules:

- ❑ Ethernet Management Module V3.20
- ❑ Token Ring Management Module V3.00
- ❑ FDDI Management Module V1.01

When an ONline management module is installed in a concentrator, all of the dip switch settings on the 10BASE-FL Module are overridden.

When you first install the module:

1. The network (channel) defaults to isolated mode. The ports are automatically disabled so that unapproved users cannot be added. Therefore, you must enable the ports you wish to use and set the module to the appropriate Ethernet network through the management commands.

2. All other module settings retain the same default values as the dip switch default values. Therefore, you only change these values through management if you do not want the default values.

This section describes the management commands to set these features. For additional information on the available network management features, refer to:

- ❑ The appropriate ONline Management Module Installation and Operation Guide
- ❑ *ONline Management Commands Guide*

Enabling Ports

You can enable or disable each of the four ports on the module. When a port is enabled, it can transmit data onto and receive data from the network to which the module is assigned.

To enable or disable a specific port, use the following management command:

```
SET PORT {slot.port} MODE {enable}
         {slot.all}       {disable}
```

Selecting a Network

The ONline 10BASE-FL Module is equipped with the technology to work with the ONline Concentrator's unique TriChannel™ Architecture. This feature lets you assign the module to any of three networks (or none) on the ONline System Concentrator backplane. Refer to the *ONline System Concentrator Installation and Operation Guide,* Chapter 1, for a discussion of the ONline TriChannel Architecture.

To set the module to a network or set it to isolated mode, use the following management command:

```
SET MODULE {slot} NETWORK {ethernet_1}
                          {ethernet_2}
                          {ethernet_3}
                          {isolated}
```

Note: The dip switch settings on the module refer to the backplane connection as the "channel" connection. The channel setting and the network setting are the same. Modules set to the same network communicate with each other.

Enabling Port Redundancy

You can enable port redundancy in one of the following ways:

- If you have network management, you can enable or disable main port redundancy between any two ports on the 10BASE-FL Module.
- If you do not have management, you can use the dip switches on the module to configure redundancy between ports 1 and 2 on the module and/or ports 3 and 4.

For example, when you enable redundancy:

1. Port 1 becomes the primary link and port 2 is the redundant link.
2. If the primary link (port 1) fails, the redundant link (port 2) is engaged automatically, thus preventing a network failure.
3. When you disable redundancy, each port works independently.

Note: Enabling port redundancy for two ports automatically enables the ports themselves, even if the ports were previously disabled.

The redundancy status LEDs, located between the sets of port LEDs and the port connectors on the 10BASE-FL Module, are:

- **Off** - When you disable redundancy (default setting).
- **On** - When you enable redundancy.

For information about the redundancy LEDs, refer to Table 3-5.

To set redundancy between ports, use the following management command:

```
SET PORT {slot.port} MODE REDUNDANT {slot.port}
```

To turn off redundancy between ports, use the MODE NON_REDUNDANT option. Redundancy configurations are shown in Chapter 2, Designing and Expanding the Network.

Note: If you enable redundancy on one end of a link, you must enable Remote Failure Signaling (RFS) at the other end. For more information, refer to the next section, Enabling Remote Failure Signaling.

Enabling Remote Failure Signaling

Due to the nature of the 10BASE-FL standard, the receive path of a redundant port can detect no light and partition errors, but the transmit path cannot detect these errors. Remote Failure Signaling (RFS) provides a way for transmit failures to be detected so that a switchover from a primary to a backup port can occur. You can enable RFS for any of the four ports on your module. When you connect two 10BASE-FL Modules and enable redundancy between two ports on one of the modules, you *must* enable RFS on the corresponding ports of the other module.

For example, if you enable redundancy between ports 1 and 2 on 10BASE-FL Module #1 and these ports are connected to ports 1 and 2 on Module #2, you must enable RFS on ports 1 and 2 on 10BASE-FL Module #2 (Figure 3-4). Note that RFS is automatically disabled when you disable redundancy on the corresponding port or disable the port.

.

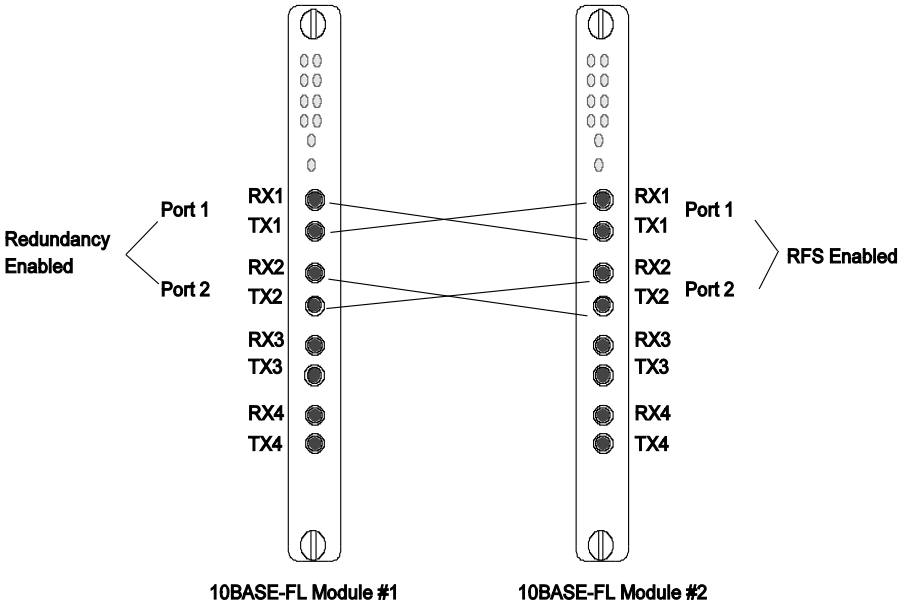

Figure 3-4. 10BASE-FL Modules Connected with Redundancy/RFS Enabled

To enable RFS for a port, issue the following management command:

```
SET PORT {slot.port} MODE REMOTE_FAILURE_SIGNALING
```

Saving Module Configuration

To save the module and port settings to management module memory, issue the following command:

```
SAVE MODULE_PORT
```

Showing Module Configuration

You can display status information about the 10BASE-FL Module using the following commands:

- SHOW MODULE
- SHOW MODULE VERBOSE
- SHOW PORT
- SHOW PORT VERBOSE

For example, the following command displays detailed information about port 1 on an 10BASE-FL Module in slot 6 of the concentrator.

```
ONline> show port 6.1 verbose     [ENTER]
Port Display for Module 5104M-FL
Port     Mode       Status      Network       General  Information
06.01   ENABLED     OKAY        ISOLATED
Port Connector                  FIBER
Mode Dip Setting:               ENABLED
```

This display tells you the status of the specific port. It includes the management module and dip switch settings from the board. For more information on the SHOW commands, refer to the:

- Appropriate *ONline Management Module Installation and Operation Guide*
- *ONline Management Commands Guide*

Monitoring the Front Panel

The LEDs on the front panel of the 10BASE-FL Module allow you to monitor the status of each port. The 10BASE-FL Module has 10 LEDs on the front panel that allow you to monitor diagnostic, activity, and redundancy status for each port.

Figure 3-5 shows the location of these indicators

.

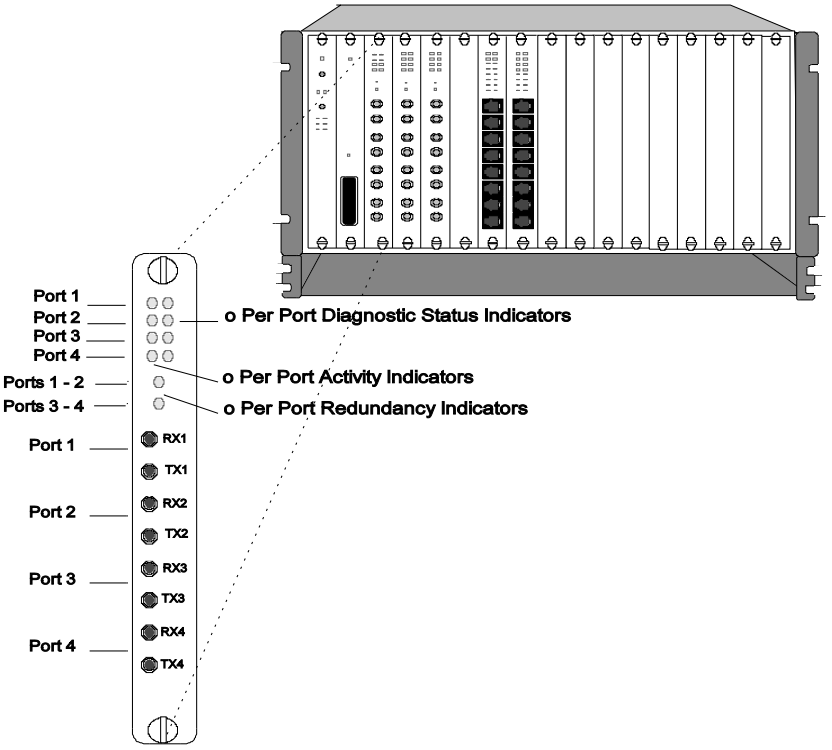

Figure 3-5. 10BASE-FL Module Faceplate and ONline System Concentrator

Table 3-5 describes how to interpret the 10BASE-FL Module LEDs.

Table 3-5. Interpreting the 10BASE-FL Module LEDs

LED Name	Color	State	Indicates
Activity (Ports 1-4)	Yellow	Off	No packets are received on the fiber segment.
		On	Constant activity on the fiber segment.
		Blinking	Module receives packets from segment to which it is attached.
Status (Ports 1-4)	Green	Off	Port disabled.
		On	Port enabled or in standby and link integrity is OK.
		1 blink	No light detected.
		2 blinks	Port partitioned.
		3 blinks	FIFO error or MAU jabber lockup protection.
Redundancy (Ports 1&2) (Ports 3&4)	Green	Off	Redundancy is disabled; ports are independent of each other.
		On	Redundancy is enabled between ports 1 and 2 and/or 3 and 4.
		Blinking	Redundancy is enabled between ports 1 and 2 and/or 3 and 4 and there is a failure on one of these ports.

Verifying the LED and Network Assignments

Once you install the module, verify its operation through the front panel of the ONline Controller Module. The Controller Module is equipped with an LED check button on the front panel. Use the LED check button to:

- ❑ Verify LED operation
- ❑ Verify network (channel) assignment

When you press this button, the Controller Module initiates a test to all modules in the concentrator. All LEDs should respond by lighting continuously for approximately five seconds. Any LED that does not light is defective.

After the 5 seconds elapse, the diagnostic continues with a network (channel) check of all modules. Each Status LED should respond by blinking the number of times to correspond with the network to which the module is assigned. The network check sequence repeats five times. Table 3-6 explains the network check codes.

Table 3-6. Network Check Codes

LED State	Module Is Configured for...
1 Blink	Network 1
2 Blinks	Network 2
3 Blinks	Network 3
Off	Isolated mode (operates independent of any network)

4 Troubleshooting

This chapter describes fault conditions and troubleshooting suggestions for the 10BASE-FL Module.

This chapter contains the following sections:

- Troubleshooting Using the Port Activity LEDs
- Troubleshooting Using the Port Status LEDs
- RFS Troubleshooting
- Technical Assistance

Note: Do not connect a 10BASE-FL Module to an ONline Ethernet Fiber Module, fiber transceiver, or any other non-10BASE-FL compliant or FOIRL- compatible product. ONline fiber products use 10BASE-FB signaling, which are incompatible with the 10BASE-FL protocol and FOIRL.

Troubleshooting Using the Port Activity LEDs

If a port Activity LED does not light, use the Table 4-1 to help troubleshoot the problem.

Table 4-1. Troubleshooting Using the Port Activity LEDs

LED Name	LED State	Possible Cause	Corrective Action
Activity (Ports) 1 - 4)	Off	There is no traffic received from the segment.	None.
		Port is disabled.	Enable the port.
		Power is off.	Check the Controller Module Power LED.
		Activity LED has burnt out.	Press the LED check button on the Controller Module.
		10BASE-FL Module port is faulty.	Connect the cable to a different port.
		10BASE-FL Module is faulty.	Try a different 10BASE-FL Module.
		Backplane connection is bad.	Reinsert the 10BASE-FLModule.If this fails, try another concentrator slot.

Troubleshooting Using the Port Status LEDs

A blinking Port Status indicator is always a sign that the port detects a potential problem. Once a port detects a problem, you can further analyze the problem by counting the number of blinks. Table 4-2 provides troubleshooting suggestions for each blinking sequence.

Table 4-2. Troubleshooting Using the Port Status LEDs

LED State	Indication	Possible Cause	Corrective Action
Off	Port Disabled	Port disabled.	Enable port.
		10BASE-FL Module not powered.	Check concentrator power status.
			Reinsert 10BASE-FL Module.
		Broken LED.	Press LED check button on Controller Module.
		Bad 10BASE-FL Module.	Replace Module.
1 Blink	No Light Received	Cables crossed.	Verify TX on remote device is connected to RX on 10BASE-FL Module.
		Broken fiber cable.	Check and fix RX fiber link.
		Bad fiber connections.	Clean and reconnect fiber (both ends).

Table 4-2. Troubleshooting Using the Port Status LEDs

LED State	Indication	Possible Cause	Corrective Action
1 Blink (continued)	No Light Received	Insufficient optical power received.	Check 10BASE-FL Module optical power using a light meter.
			Check optical power of remote device.
			If optical power levels are OK, check cable; it may be bad or too long.
		Bad remote device.	Replace remote device.
		Bad 10BASE-FL Module.	Replace module.
2 Blinks	Port Partitioned	Bad fiber connections.	Clean and reconnect fiber (both ends).
		Bad remote device.	Replace remote device.
		Broken fiber.	Check and fix RX fiber link.
		Bad 10BASE-FL Module.	Replace Module.
3 Blinks	FIFO error or MAU jabber lockup protection	Check optical power.	Verify that optical power level is correct.
		Bad fiber connections.	Clean and reconnect TX fiber (both ends).
		Broken or cracked fiber.	Check and fix RX fiber link.

Table 4-2. Troubleshooting Using the Port Status LEDs

LED State	Indication	Possible Cause	Corrective Action
3 Blinks (continued)	FIFO error or MAU jabber lockup protection	Bad unit or non-10BASE-FL equipment at other end.	Try another port or replace other unit.
		Bad 10BASE-FL Module.	Replace module.

RFS Troubleshooting

When you enable redundancy for a port on one 10BASE-FL Module (splices), you must enable Remote Failure Signaling (RFS) on the corresponding port of the remote 10BASE-FL Module to which it is connected. If you accidentally enable RFS on both sides of a 10BASE-FL link, the link may fail because each side "thinks" it is the remote end of the link.

In addition, when you enable redundancy on both sides of a 10BASE-FL link and the primary port fails, the backup port on the remote end of the link does not take over because the port "thinks" it is the primary port.

Technical Assistance

You can receive assistance for installing and troubleshooting the 10BASE-FL Module by calling either your 3Com reseller or 3Com Technical Support. Be prepared to supply a representative with the following information:

- Description of the problem
- Steps you have taken to try and correct the problem
- Type and software version of the ONline management module being used

- ❑ Version of software installed on your 10BASE-FL Module
- ❑ Status of the front panel LEDs
- ❑ Configuration of your concentrator
  (you may find it helpful to refer to the Slot Usage Chart in Appendix B of the *ONline System Concentrator Installation and Operation Guide* for a record of this information)

Refer to Appendix B for instructions on contacting Technical Support for your product.

A Specifications

This appendix lists specifications for the 10BASE-FL Module, including:

- General Specifications
- Optical Specifications
- Power Requirements
- Environmental Specifications
- Mechanical Specifications
- 10BASE-FL Cable and Connector Specifications

General Specifications

Table A-1 lists general specifications for the 10BASE-FL Module.

Table A-1. General Specifications

10BASE-FL Module Model number	5104M-FL1
Collision Detection	100% deterministic
Configuration Rules	Compliant with IEEE 802.3 10BASE-FL and FOIRL specifications
Maximum Number of Nodes	1024
Backplane Interface	96-pin edge connector, compatible with the 3Com ONline System Concentrator
External Connector	4 pairs of fiber ports (ST, SMA, or FC connectors)
Host Interface	ONline System Concentrator bus interface standard
Installation Attachment	Two thumbscrews on the mounting bracket

Optical Specifications

This section lists the optical specifications for the 10BASE-FL Module, including:

- ❑ Transmitter Specifications
- ❑ Receiver Specifications
- ❑ Supported Fiber Optic Cables
- ❑ Fiber Optic Interface

Transmitter Specifications

Light Source: GaA1As LED at wavelength 820 ± 20 nm. Power coupled into fiber cable inclusive of ST, SMA, or FC connector loss.

Table A-2 lists transmit power specifications.

Table A-2. Transmit Power (Peak Values)

- 6.5 dBm (± 3.0 dBm)	100/140 micron, 0.29 NA fiber
- 9.0 dBm (± 3.0 dBm)	85/125 micron, 0.29 NA fiber
- 12.0 dBm (± 3.0 dBm)	62.5/125 micron, 0.275 NA fiber
- 16.5 dBm (± 3.0 dBm)	50/125 micron, 0.20 NA fiber

Receiver Specifications

Table A-3 lists receiver specifications for the 10BASE-FL Module.

Table A-3. Receiver Specifications

Light Detector	Silicon PIN photodiode
Input Range	Optical power input of -8.0 dBm to -29.5 dBm (peak values)
Bit Error Rate	1 in 10^{-9} over dynamic range
Dynamic Range	21.5 dB

Supported Fiber Optic Cables

You can use the following fiber optic cables with the 10BASE-FL Module:

- ❑ 50/125
- ❑ 62.5/125
- ❑ 85/125
- ❑ 100/140

The fiber optic cable must be:

- ❑ Micron diameter graded index
- ❑ Duplex fiber
- ❑ 150 MHz km rating or better

Fiber Optic Interface

Table A-4 lists specifications for the fiber optic interface.

Table A-4. Fiber Optic Interface Specifications

Data Rate	10 Mbps (million bits per second)
Data Modulation	Manchester
Fiber Optic Interface	ST-, SMA-, and FC-type

Power Requirements

Table A-5 lists power requirements for the 10BASE-FL Module.

Table A-5. Power Requirements

Power Requirements	2.0 Amp @ 5 V
Fuse	4.0 Amps for 5 V, Fast blow
Power Consumption	10 watts
BTU/hour	34.13

Environmental Specifications

Table A-6 lists electrical specifications for the 10BASE-FL Module.

Table A-6. Electrical Specifications

Operating Temperature	0° to 50° C (32° to 122° F)
Storage Temperature	-30° to 65° C (-22° to 149° F)
Humidity	Less than 95%, non-condensing

Mechanical Specifications

Table A-7 lists mechanical specifications for the 10BASE-FL Module.

Table A-7. Mechanical Specifications

Dimensions	1.0" W x 10.25" L x 8.5" H (2.54 cm x 26.04 cm x 21.6 cm)
Weight	1.25 lb. (0.57 kg.)

10BASE-FL Cable and Connector Specifications

This section contains information on 10BASE-FL and fiber products, cables, and connectors. Use the information in the following sections to ensure that the cables and connecting hardware meet requirements.

In addition to the ONline Ethernet 10BASE-FL Module, 3Com offers the ONline 10BASE-FL Transceiver (Model Number 5101T-FL1-ST, 5101T-FL1-SMA, or 5101T-FL1-FC). The 10BASE-FL Transceiver connects the ONline 10BASE-FL Module to the fiber or 10BASE-FL network.

Fiber Cables and Connectors

You can use several types of fiber cables and connectors to link your 10BASE-FL Module to your network. These cables and connectors are explained in the sections that follow. For proper operation, use only approved cables when you install all equipment.

Fiber Cables

The fiber optic cable diameters that the 10BASE-FL Module supports must meet the following qualifications:

- 50/125, 62.5/125, 85/125, or 100/140 µm graded index fiber
- Duplex fiber with a 150 MHzKm rating or better

Note that network link distances are affected by the grade of cable you choose. The quality of fiber cable varies significantly. Typically, measure quality in terms of the signal loss per kilometer. The less amount of loss the cable has, the better the cable quality is. Good quality 62.5 µm fiber typically has a 3 to 4 dB loss per kilometer.

Fiber Connectors

The 10BASE-FL Module is available in ST-, SMA-, and FC-type fiber connectors for direct connection to a Fiber Ethernet LAN. When you order the 10BASE-FL Module, use the part number listed in Table A-8 for the correct connector type.

Table A-8. Connector Type Part Number

Connector Type	Part Number
ST	5104M-FL1-ST
SMA	5104M-FL1-SMA
FC	5104M-FL1-FC

Connecting Fiber Cables

If you use a concentrator in your network setup, connect cables first at the active concentrator location. Refer to the *ONline System Concentrator Installation and Operation Guide* for more information about the concentrator connections and configuration rules.

B Technical Support

3Com provides easy access to technical support information through a variety of services. This appendix describes the following services:

- On-line Technical Support
- Support from Your Network Supplier
- Support from 3Com
- Returning Products for Repair
- Accessing the 3Com MIB
- 3Com Technical Publications

On-line Technical Support

3Com offers worldwide product support through the following on-line systems:

- Email Technical Support
- World Wide Web Site

Email Technical Support

You can contact the Integrated Systems Division (formerly Chipcom) on the Internet for technical support using the e-mail address techsupp@chipcom.com.

World Wide Web Site

You can access the latest networking information on the 3Com World Wide Web site by entering our URL into your Internet browser:

http://www.3Com.com/

This service features news and information about 3Com products, customer service and support, the 3Com latest news releases, selected articles from 3TECH™, the 3Com award-winning technical journal, and more.

You can contact the Integrated Systems Division on the World Wide Web by entering our URL into your Internet browser:

http://www.chipcom.com/

There are links between both WWW pages to view information from all 3Com divisions.

Support from Your Network Supplier

If additional assistance is required, contact your network supplier. Many suppliers are authorized 3Com service partners who are qualified to provide a variety of services, including network planning, installation, hardware maintenance, application training, and support services.

When you contact your network supplier for assistance, have the following information ready:

- Diagnostic error messages
- A list of system hardware and software, including revision levels
- Details about recent configuration changes, if applicable

If you are unable to contact your network supplier, see the following section on how to contact 3Com.

Support from 3Com

If you are unable to receive support from your network supplier, technical support contracts are available from 3Com.

For direct access to customer service for Integrated Systems Division products in:

- U.S.A. and Canada - call (800) 724-2447
- Asia Pacific - call (508) 787-5151
- Europe – refer to the table below. For European countries not listed, call 31 30 60 299 00.

Country	Telephone Number
Belgium	0800 71429
Denmark	800 17309
Finland	0800 113153
France	05 917959
Germany	0130 821502
Ireland	1 800 553117
Italy	1678 79489

Country	Telephone Number
Netherlands	06 0227788
Norway	800 11376
Spain	900 983125
Sweden	020 795482
U.K.	0800 966197
U.S.	800 876-3266

For access to customer service for all 3Com products, call (800) 876-3266.

You can also contact the Integrated Systems Division (ISD) on the Internet by using the e-mail address techsupp@chipcom.com.

Returning Products for Repair

A product sent directly to 3Com for repair must first be assigned a Return Materials Authorization (RMA) number. A product sent to 3Com without an RMA number will be returned to the sender unopened, at the sender's expense.

To obtain an RMA number for Integrated Systems Division products (formerly Chipcom), use the following numbers.

Country	Telephone Number	Fax Number
U.S. and Canada	(800) 724-2447	(508) 787-3400
Europe	(44) (1442) 275860	No Fax
Asia Pacific	(508) 787-5296	(508) 787-3400

Accessing the 3Com MIB

The 3Com Management Information Base (MIB) for the Integrated Systems Division describes commands that enable you to manage 3Com SNMP-based products. The MIB is available over the Internet on an anonymous FTP server. Updates to these MIBs are released as new 3Com products are introduced.

To access Internet versions:

1. FTP to `ftp.chipcom.com` (151.104.9.65).
2. Enter the login name `anonymous`.

3. Enter your full Internet e-mail address as the password (for example, `jdoe@company.com`).

4. Change to the mib or schema directory using the `cd /pub/mibs` or `cd /pub/mibs/schemas` command.

5. To view the 3Com MIB, OID, or schema entries, enter the `dir` command.

   - ❑ To pause the display, press [CTRL-S].
   - ❑ To continue the display, press [CTRL-Q].

6. Copy the MIB, OID, or schema files to your current directory using the appropriate command (for example, `get chipcom.mib`).

7. To exit the FTP session, invoke the `quit` command.

3Com Technical Publications

If you have comments or questions on 3Com Integrated Systems Division Technical Publications documents, please contact the Technical Publications group by FAX (508) 229-1551.

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